

# Package ‘optiscale’

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**Type** Package

**Title** Optimal Scaling

**Version** 1.2.3

**Date** 2024-05-15

**Description** Optimal scaling of a data vector, relative to a set of targets, is obtained through a least-squares transformation subject to appropriate measurement constraints. The targets are usually predicted values from a statistical model. If the data are nominal level, then the transformation must be identity-preserving. If the data are ordinal level, then the transformation must be monotonic. If the data are discrete, then tied data values must remain tied in the optimal transformation. If the data are continuous, then tied data values can be untied in the optimal transformation.

**License** GPL-2

**Depends** lattice

**LazyLoad** yes

**NeedsCompilation** no

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## R topics documented:

optiscale-package . . . . .	2
elec92 . . . . .	3
Methods . . . . .	4
opscale . . . . .	5
os.plot . . . . .	7
shepard . . . . .	8
stress . . . . .	9

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optiscale-package      *Optimal Scaling of a Data Vector*

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### Description

This package provides tools to perform an optimal scaling analysis on a data vector. The main result of the optimal scaling is a vector of scores which are a least-squares approximation to a vector of quantitative values, subject to measurement constraints based upon a vector of qualitative data values. See Young (1981) for details.

### Details

```
Package:    optiscale
Type:      Package
Version:    1.2.2
Date:      2021-02-02
License:    GPL-2
LazyLoad:  yes
```

The function that performs the optimal scaling is `opscale()`. It produces an object of class "op-scale". Generic methods are defined for `print`, `summary`, and `plot` (graphing optimally-scaled values versus original data values).

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### References

Young, Forrest W. (1981) "Quantitative Analysis of Qualitative Data." *Psychometrika* 46: 357-388.

### See Also

[opscale](#), [plot.opscale](#), [print.opscale](#), [summary.opscale](#)

### Examples

```
### x1 is vector of qualitative data
### x2 is vector of quantitative values
      x1 <- c(1,1,1,1,2,2,2,3,3,3,3,3)
      x2 <- c(3,2,2,2,1,2,3,4,5,2,6,6,4)
### Optimal scaling, specifying that x1
### is ordinal-discrete
op.scaled <- opscale(x.qual=x1, x.quant=x2,
```

```
          level=2, process=1)
print(op.scaled)
summary(op.scaled)
```

---

elec92

*Public Opinion During the 1992 U.S. Presidential Election*

---

## Description

This data set contains several variables from the Center for Political Studies 1992 National Election Study. Observations with missing values on any of the variables have been deleted.

## Usage

```
data(elec92)
```

## Format

A data frame with 1653 observations on the following 7 variables.

caseid NES case identification number

bush Respondents feeling thermometer rating of George H. W. Bush

ideol Respondents ideological self-placement, seven-point scale ranging from 1=extremely liberal to 7=extremely conservative

econ4yr Respondents judgment whether national economy has gotten better or worse over preceding four years, five-point scale ranging from 1=much better to 5=much worse

party Respondents party identification, seven-point scale ranging from 0=strong Democrat to 6=strong Republican

choice Difference in respondents feeling thermometer ratings of Bush and Clinton

clinton Respondent's feeling thermometer rating of Bill Clinton

## Source

The full data set from which these observations and variables were extracted is available on the Study Page for the American National Election Studies 1992 Time Series Study, at <https://electionstudies.org/data-center/1992-time-series-study/>.

## References

Jacoby, William G. (1999) "Levels of Measurement and Political Research: An Optimistic View." *American Journal of Political Science* 43: 271-301.

## Examples

```
library(optiscale)
data(elec92)
summary(lm(choice ~ party + ideol + econ4yr, data = elec92))
```

---

Methods

*S3 methods for opscale*

---

## Description

Plot, print, shepard, stress, and summary methods for objects of class opscale

## Usage

```
## S3 method for class 'opscale'  
plot(x, ...)  
## S3 method for class 'opscale'  
print(x, ...)  
## S3 method for class 'opscale'  
summary(object, ...)
```

## Arguments

object	Object of class opscale
x	Object of class opscale
...	Ignored

## Details

Method print returns a listing of the data. summary describes the optimal scale transformation. plot calls os.plot and returns an object of class trellis that graphs optimally-scaled values against the original (qualitative) data values.

## See Also

[os.plot](#)

## Examples

```
### x1 is vector of qualitative data  
### x2 is vector of quantitative values  
x1 <- c(1,1,1,1,2,2,2,3,3,3,3,3)  
x2 <- c(3,2,2,2,1,2,3,4,5,2,6,6,4)  
### Optimal scaling, specifying that x1  
### is ordinal-discrete  
op.scaled <- opscale(x.qual=x1, x.quant=x2,  
                    level=2, process=1)  
print(op.scaled)  
summary(op.scaled)  
plot(op.scaled)
```

opscale

*Optimal scaling of a data vector***Description**

This function produces an object of class "opscale", containing a vector that is a least-squares approximation to a vector of quantitative values, subject to measurement constraints based upon a vector of qualitative data values.

**Usage**

```
opscale(x.qual, x.quant = seq(1:length(x.qual)), level = 1,
        process = 1, na.impute = FALSE,
        na.assign = TRUE, rescale = TRUE)
```

**Arguments**

x.qual	A vector of data values, assumed to be qualitative.
x.quant	A vector of quantitative values.
level	Measurement level of x.qual. 1=nominal, 2=ordinal.
process	Measurement process of x.qual. 1=discrete, 2=continuous.
na.impute	If TRUE, then assign x.quant values to optimally scaled vector for missing entries in x.qual. of FALSE then assign NA to entries in optimally scaled vector corresponding to missing entries in x.qual.
na.assign	If TRUE, then if x.quant is missing, assign mean of optimally scaled values for the corresponding x.qual value to the optimally scaled vector. If FALSE, then leave optimally scaled value missing, even if x.qual value is present.
rescale	If TRUE then rescale optimally scaled vector to same mean and standard deviation as x.qual.

**Details**

The `opscale()` function operationalizes a measurement theory proposed by Young (1981) in order to facilitate an analysis strategy called "Alternating Least Squares, Optimal Scaling". The optimal scaling transformation produces a vector (say, OS) that is a least-squares approximation to `x.quant`, subject to measurement constraints based upon `x.qual`. If `x.qual` is nominal level, then the values in OS are the conditional means of `x.quant`, within distinct categories of `x.qual`. If `x.qual` is ordinal level, then the values in OS are the conditional means of `x.quant`, adjusted to be weakly monotonic to the values in `x.qual`, using Kruskals (1964b) monotonic transformation. If `x.qual` is discrete, then all data objects sharing a common value in `x.qual` must be assigned the same value in OS. If `x.qual` is continuous, then data objects sharing a common value in `x.qual` can fall within a closed interval of values in OS. The continuous-discrete measurement process distinction corresponds to Kruskals (1964a) primary and secondary approaches to ties.

**Value**

The `opscale()` function returns an object of class "opscale" containing a list with the following components:

<code>qual</code>	The qualitative data vector, <code>x.qual</code>
<code>quant</code>	The vector of quantitative values, <code>x.quant</code>
<code>os</code>	The vector of optimally scaled values
<code>varname</code>	The name of the qualitative data vector, <code>x.qual</code>
<code>measlev</code>	The measurement level of the qualitative data vector specified in the <code>level</code> argument to <code>opscale</code>
<code>measproc</code>	The measurement process of the qualitative data vector specified in the <code>process</code> argument to <code>opscale</code>
<code>rescale</code>	Value of the <code>rescale</code> argument to <code>opscale</code>
<code>os.raw.mean</code>	Mean of optimally scaled values before rescaling
<code>os.raw.sd</code>	Standard deviation of optimally scaled values before rescaling

**References**

Kruskal, Joseph B. (1964a) "Multidimensional Scaling by Optimizing Goodness of Fit to a Non-metric Hypothesis." *Psychometrika* 29: 1-27.

Kruskal, Joseph B. (1964b) "Nonmetric Multidimensional Scaling: A Numerical Method." *Psychometrika* 29: 115-129.

Young, Forrest W. (1981) "Quantitative Analysis of Qualitative Data." *Psychometrika* 46: 357-388.

**See Also**

[plot.opscale](#), [print.opscale](#), [summary.opscale](#)

**Examples**

```
### x1 is vector of qualitative data
### x2 is vector of quantitative values
      x1 <- c(1,1,1,1,2,2,2,3,3,3,3,3)
      x2 <- c(3,2,2,2,1,2,3,4,5,2,6,6,4)
### Optimal scaling, specifying that x1
### is ordinal-discrete
op.scaled <- opscale(x.qual=x1, x.quant=x2,
                    level=2, process=1)
print(op.scaled)
summary(op.scaled)
```

---

`os.plot`*Graph of optimal scaling transformation*

---

### Description

Line and point plot showing optimally-scaled values on the vertical axis, original data values (assumed to be qualitative) on the horizontal axis.

### Usage

```
os.plot(x.qual, os.data,  
        main.title = "Plot of optimal transformation")
```

### Arguments

<code>x.qual</code>	Vector of data values, assumed to be qualitative.
<code>os.data</code>	Vector of optimally-scaled data values.
<code>main.title</code>	Main title for plot.

### Value

Object of class `trellis`.

### See Also

[plot.opscale](#),

### Examples

```
### x1 is vector of qualitative data  
### x2 is vector of quantitative values  
x1 <- c(1,1,1,1,2,2,2,3,3,3,3,3,3)  
x2 <- c(3,2,2,2,1,2,3,4,5,2,6,6,4)  
### Optimal scaling, specifying that x1  
### is ordinal-discrete  
op.scaled <- opscales(x.qual=x1, x.quant=x2,  
                     level=2, process=1)  
### Plot of optimal scaling transformation  
os.plot(op.scaled$qual, op.scaled$os)
```

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shepard	<i>Shepard diagram for opscale</i>
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### Description

Graph showing data (assumed quantitative) on vertical axis, optimally-scaled data on horizontal axis.

### Usage

```
shepard(x, ...)
```

```
shep.plot(x.quant, os.data, main.title = "Shepard Diagram")
```

### Arguments

x	An object of class opscale
x.quant	Data vector, assumed to be quantitative.
os.data	Optimally-scaled data.
main.title	Main title for graph.
...	Ignored

### Value

shepard() and shep.plot() both produce an object of class trellis

### Warning

If using shep.plot(), the Shepard diagram should be created using "raw" optimally scaled values. That is, the OS values should NOT be rescaled to the mean and standard deviation of the original qualitative data.

### Examples

```
### x1 is vector of qualitative data
### x2 is vector of quantitative values
      x1 <- c(1,1,1,1,2,2,2,3,3,3,3,3)
      x2 <- c(3,2,2,2,1,2,3,4,5,2,6,6,4)
### Optimal scaling, specifying that x1
### is ordinal-discrete, optimally scaled
### values are not rescaled
      op.scaled <- opscale(x.qual=x1, x.quant=x2,
                          level=2, process=1,
                          rescale=FALSE)
### Create Shepard diagram
      shepard(op.scaled)
### Same results are produced by:
      shep.plot(op.scaled$quant, op.scaled$os)
```



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stress	<i>Stress coefficients for opscale</i>
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---

**Description**

Calculates stress coefficients summarizing lack of fit between two vectors.

**Usage**

```
stress(x, ...)

calc.stress(quant, os, rescale = FALSE,
            os.raw.mean = mean(os, na.rm = TRUE),
            os.raw.sd = sd(os, na.rm = TRUE))
```

**Arguments**

x	Object of class opscale
quant	Data vector.
os	Vector of optimally-scaled data
rescale	If TRUE, the optimally-scaled data have been rescaled to the mean and standard deviation of the original qualitative data vector that was used in the optimal scaling transformation.
os.raw.mean	User-specified mean for optimally-scaled data, defaults to mean of os. Only needed if rescale = TRUE.
os.raw.sd	User-specified standard deviation for optimally-scaled data, defaults to standard deviation of os. Only needed if rescale = TRUE.
...	Ignored

**Value**

stress() and calc.stress() both produce a vector with three elements:

stress1	Kruskals Stress 1 coefficient
stress2	Kruskals Stress 2 coefficient
raw.stress	Sum of squared residuals between quant and os

**Warning**

If using calc.stress(), the stress coefficients must be created using "raw" optimally scaled values. That is, the OS values should NOT be rescaled to the mean and standard deviation of the original qualitative data.

**Examples**

```
### x1 is vector of qualitative data
### x2 is vector of quantitative values
      x1 <- c(1,1,1,1,2,2,2,3,3,3,3,3)
      x2 <- c(3,2,2,2,1,2,3,4,5,2,6,6,4)
### Optimal scaling, specifying that x1
### is ordinal-discrete, optimally scaled
### values are not rescaled
      op.scaled <- opscale(x.qual=x1, x.quant=x2,
                          level=2, process=1,
                          rescale=FALSE)
### Calculate stress coefficients
      stress(op.scaled)
### Same results can be obtained with:
      calc.stress(op.scaled$quant, op.scaled$os)
```

# Index

## \* datasets

elec92, 3

calc.stress (stress), 9

elec92, 3

Methods, 4

opscale, 2, 5

optiscale (optiscale-package), 2

optiscale-package, 2

os.plot, 4, 7

plot.opscale, 2, 6, 7

plot.opscale (Methods), 4

print.opscale, 2, 6

print.opscale (Methods), 4

print.summary.opscale (Methods), 4

shep.plot (shepard), 8

shepard, 8

stress, 9

summary.opscale, 2, 6

summary.opscale (Methods), 4